



FIG. 1

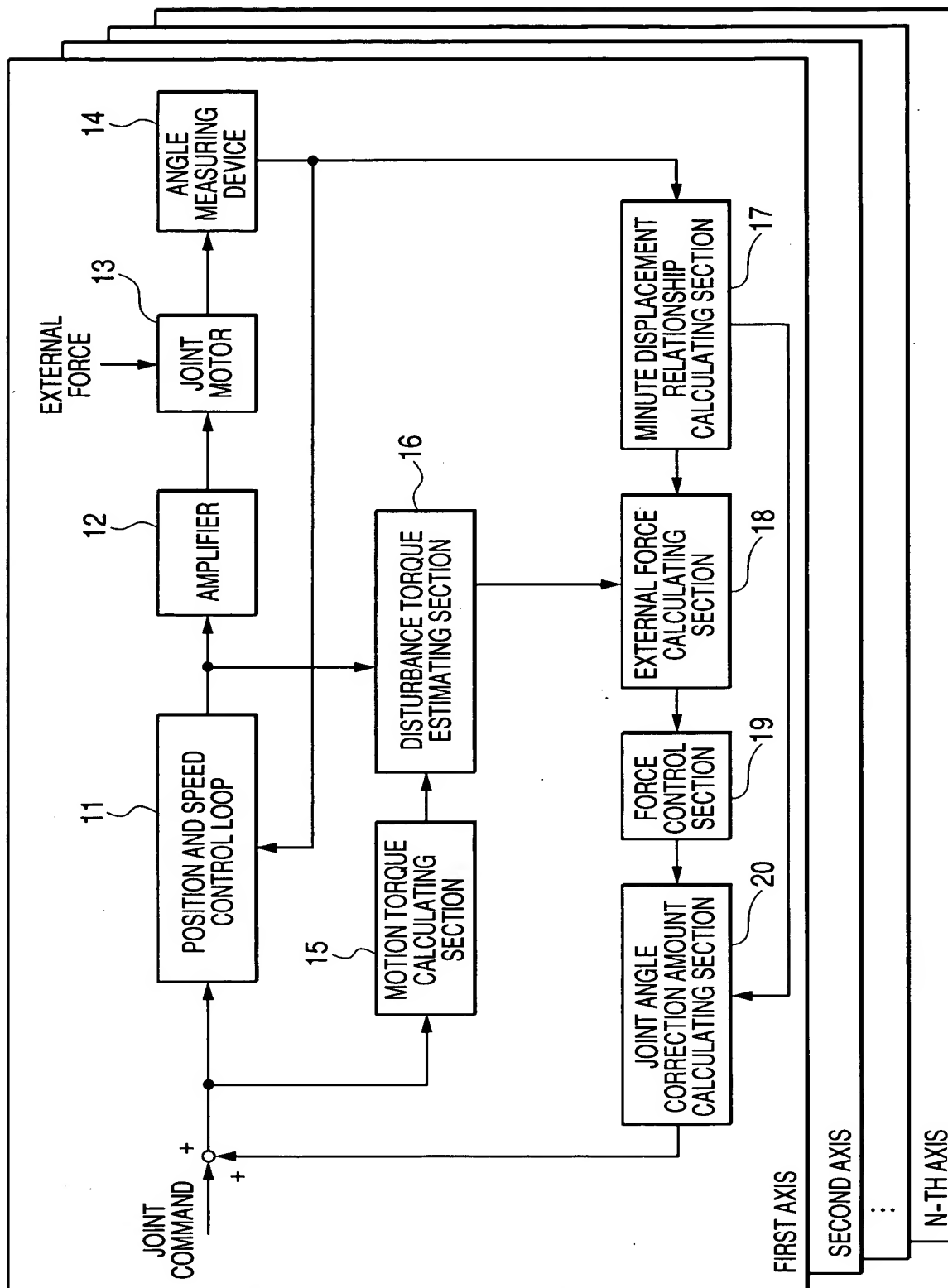


FIG. 1 is a block diagram of a multi-axis motion control system. The system is organized into several functional blocks and sections:

- Input and Feedback Loop (11):**
  - JOINT COMMAND** enters a summing junction (+).
  - ANGLE MEASURING DEVICE (14)** provides feedback to a summing junction (-).
  - The output of the first summing junction passes through gain blocks  $K_p$  (111) and  $K_v$  (112).
  - The output of  $K_v$  (112) enters a second summing junction (+).
  - The output of the second summing junction passes through an **INTEGRATION** block (114) and a **PROPORTION** block (113).
  - The output of the **PROPORTION** block (113) enters a third summing junction (+).
  - The output of the third summing junction passes through an **AMPLIFIER** (12) to the **JOINT MOTOR** (13).
- Torque Calculating Section (15):**
  - Inputs include **GRAVITY TORQUE**, **SPEED TORQUE**, and **ACCELERATION TORQUE**.
  - The **SPEED TORQUE** and **ACCELERATION TORQUE** inputs pass through integrators  $s$  and  $s^2$  respectively.
  - The outputs of these blocks are summed at a junction (+).
- Motion Torque Adding Section (22):**
  - Inputs include the output from the **Torque Calculating Section (15)** and the output from the **Impedance Control Section (26)**.
  - The outputs are summed at a junction (+).
- Impedance Control Section (26):**
  - Inputs include the output from the **Motion Torque Adding Section (22)** and the output from the **Correction Amount Selecting Section (27)**.
  - The outputs are summed at a junction (+).
- Correction Amount Selecting Section (27):**
  - Inputs include the output from the **Impedance Control Section (26)** and the output from the **Angle Measuring Device (14)**.
  - The outputs are summed at a junction (+).
- Output and Feedback:**
  - The output of the **Correction Amount Selecting Section (27)** is summed with the **JOINT COMMAND** at the first summing junction.
  - The output of the **Impedance Control Section (26)** is summed with the output of the **Motion Torque Adding Section (22)** at the second summing junction.
  - The output of the **Motion Torque Adding Section (22)** is summed with the output of the **Impedance Control Section (26)** at the third summing junction.
  - The output of the **Impedance Control Section (26)** is summed with the output of the **Correction Amount Selecting Section (27)** at the fourth summing junction.
  - The output of the **Correction Amount Selecting Section (27)** is summed with the output of the **Angle Measuring Device (14)** at the fifth summing junction.

The system is divided into a **FIRST AXIS**, **SECOND AXIS**, and **N-TH AXIS**.

FIG. 3

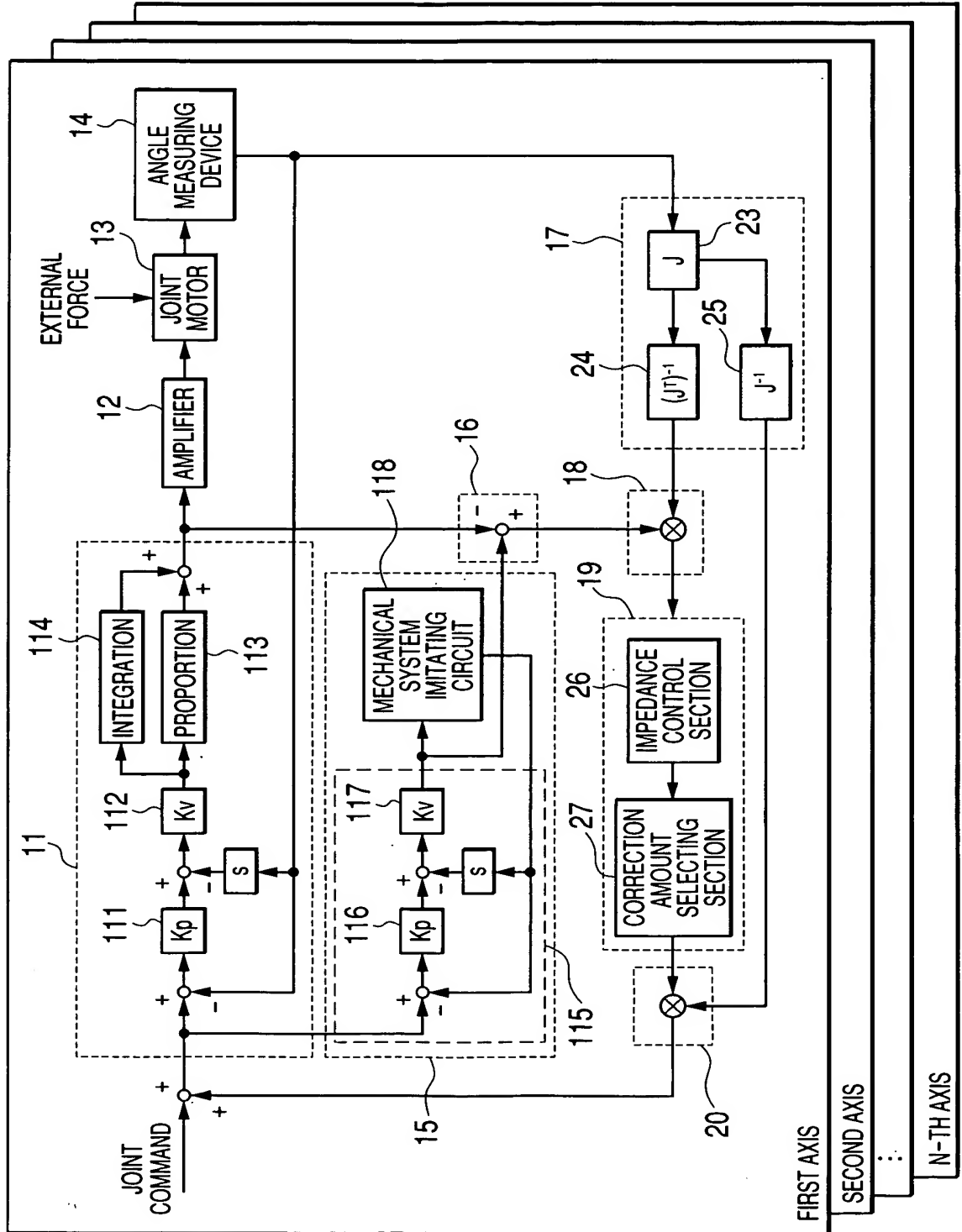
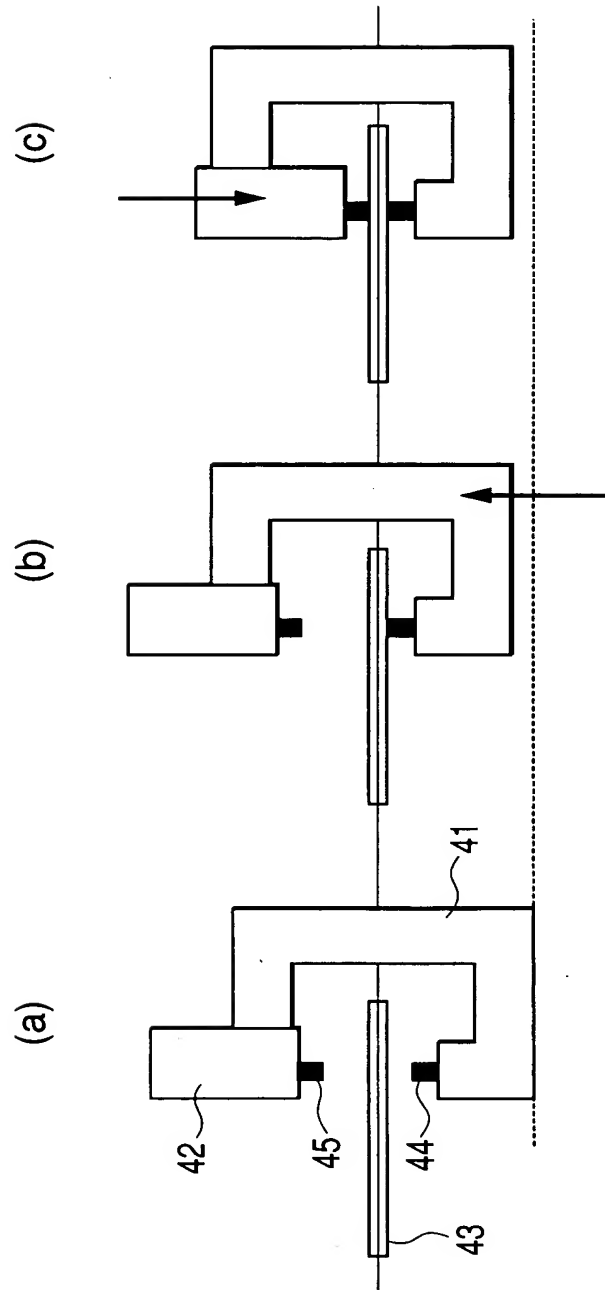
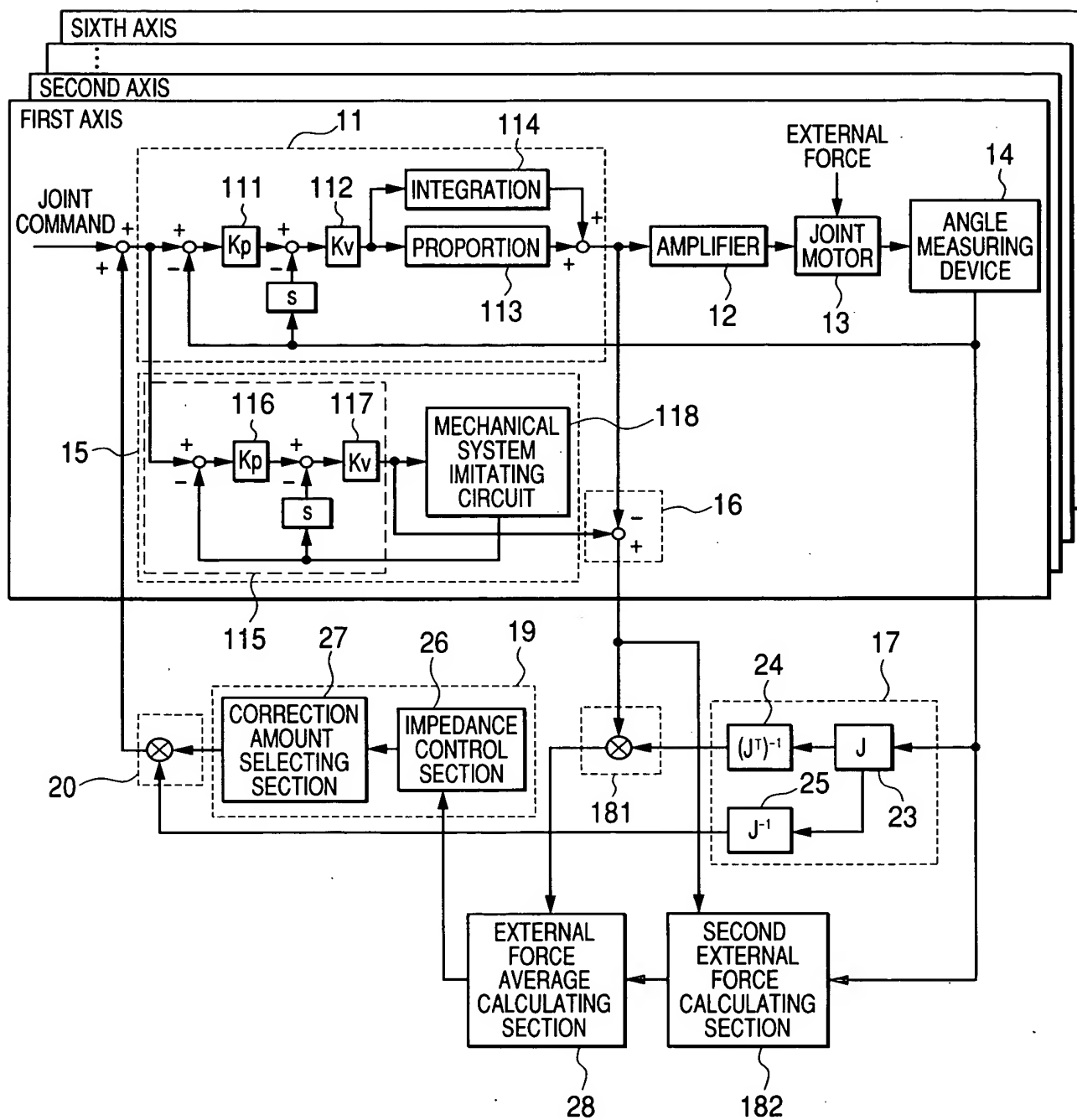


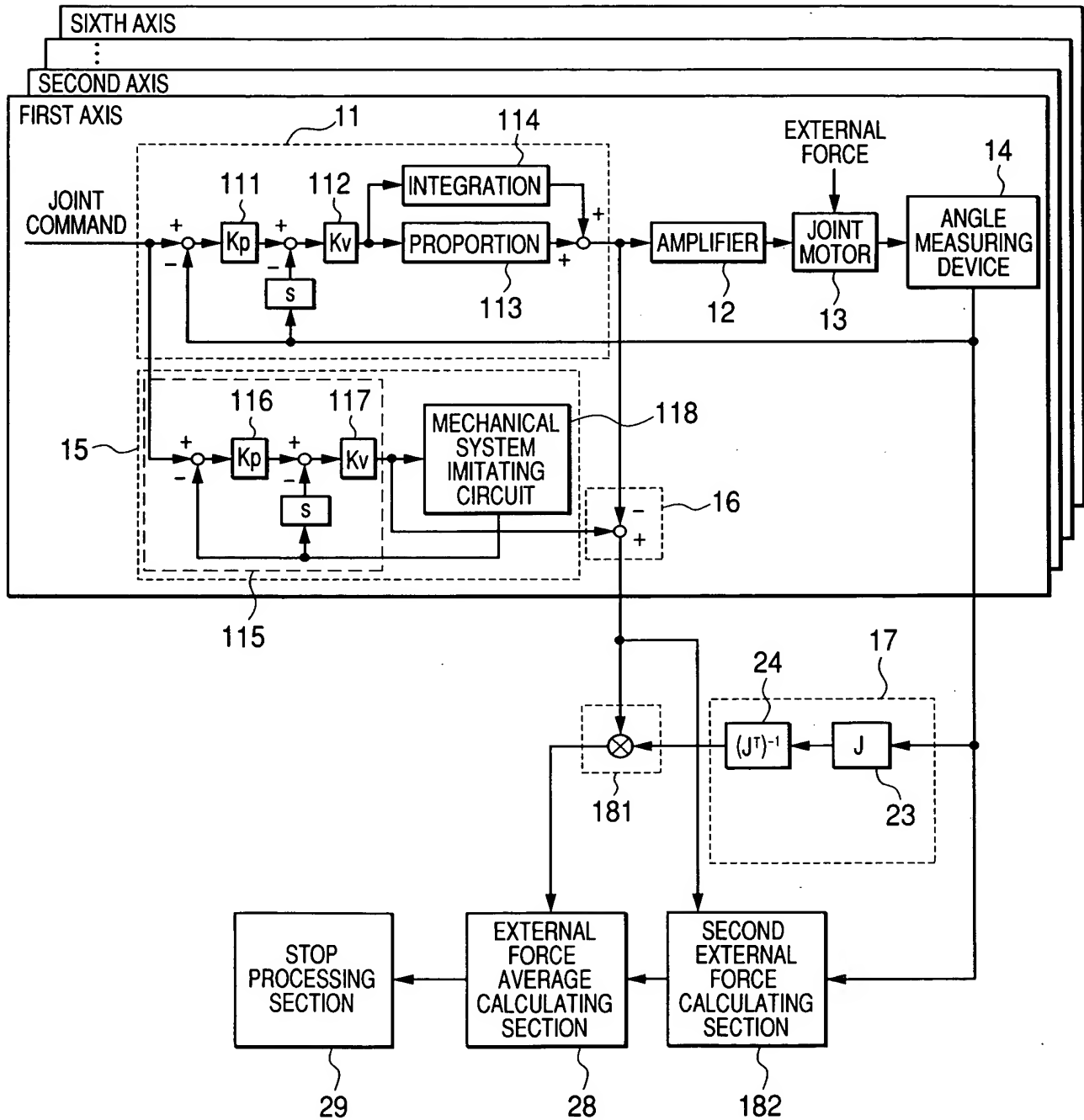
FIG. 4



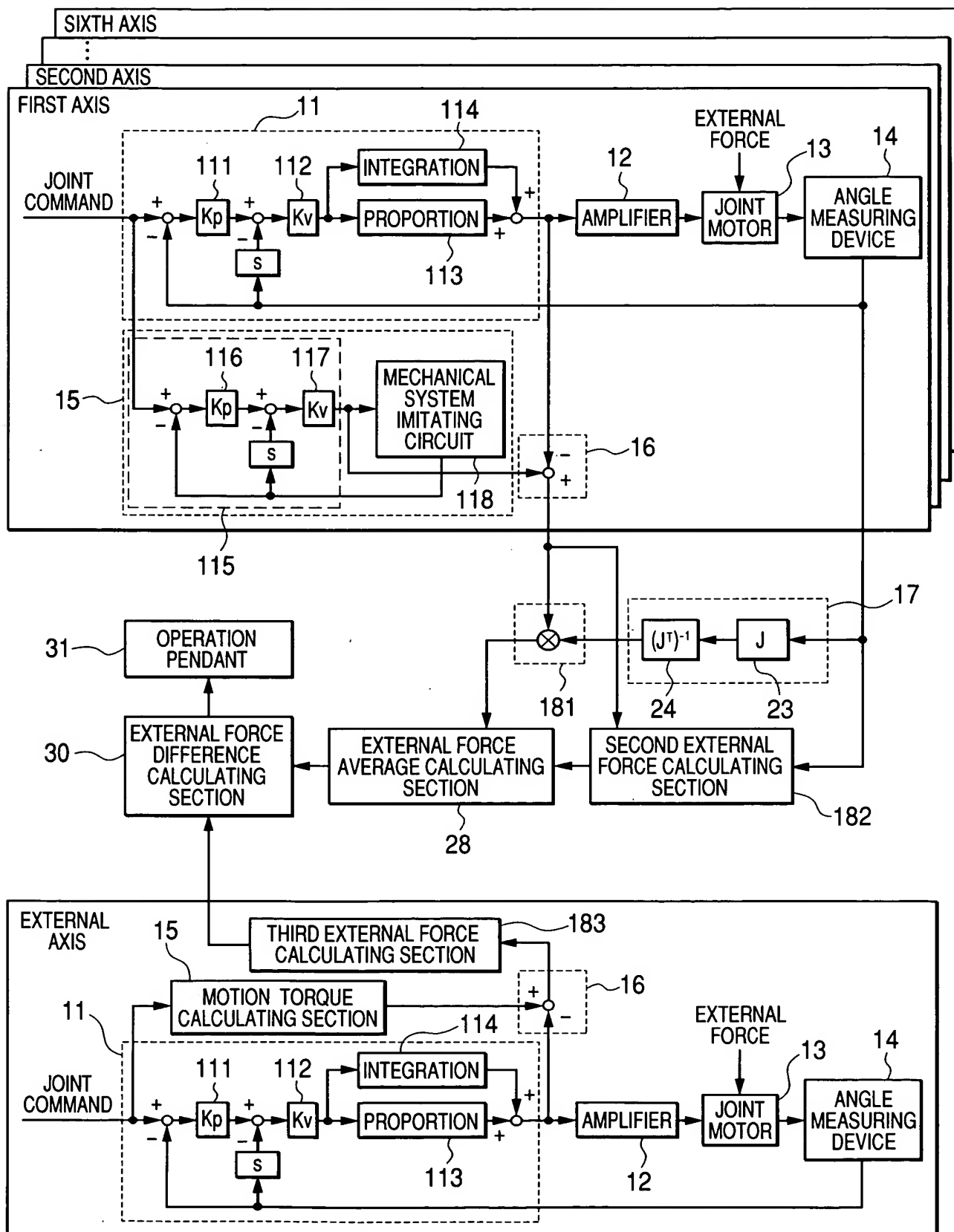
**FIG. 5**



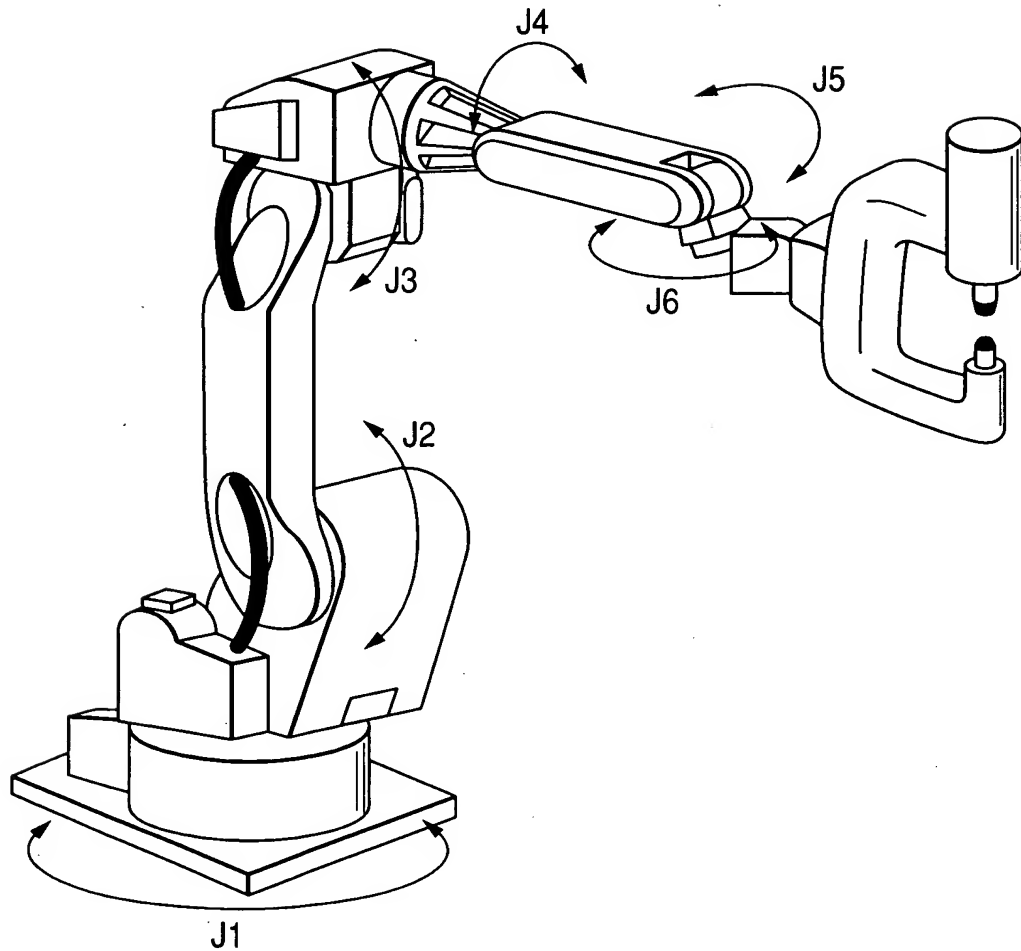
**FIG. 6**



**FIG. 7**

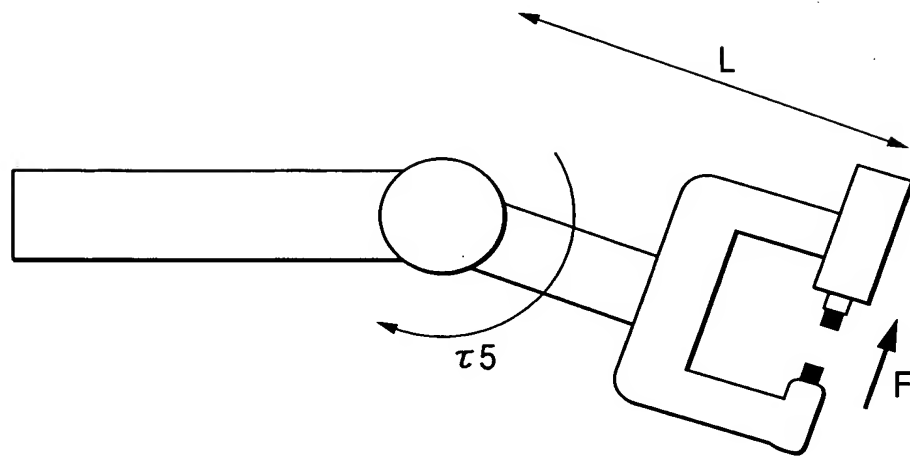


**FIG. 8**

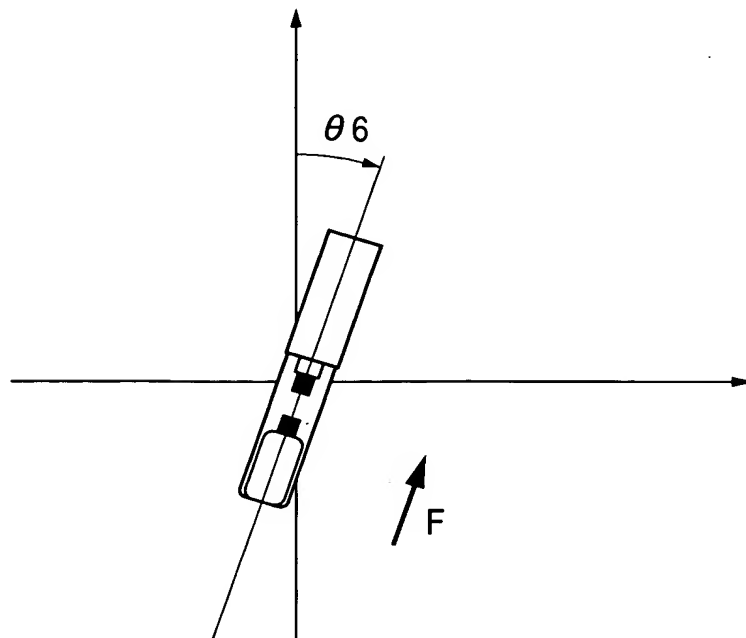




**FIG. 9A**



**FIG. 9B**



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FIG. 10

